QHeatSim MVP – Simulation Architecture and Development Plan

1. Overview

QHeatSim is the simulation core of the QHeatNet framework, designed to model quantum information transfer via thermal phase coherence rather than particle or photonic interaction. The MVP (Minimum Viable Product) will simulate a discrete thermodynamic lattice with entangled node behavior driven by entropy alignment. This document outlines the MVP architecture, computational logic, data integration, and user interface.

2. Core Objectives

- Simulate an NxN thermal lattice grid
- Allow entropy gradient injection at any node
- Model phase synchronization across nodes
- Measure quantum coherence fidelity (ΔF) over time
- Enable input of real CMB fluctuation data
- Visualize entropy propagation and phase coupling

3. Architecture Diagram (Textual)

[USER INPUT]
  ↳ Lattice Size (N), Initial Conditions, CMB Upload, α/β Coefficients

[THERMAL GRID ENGINE]
  ↳ Simulates E(x,t) field via entropy propagation rules
  ↳ $E_{ij}(t+1) = E_{ij}(t) + \alpha \nabla S_{ij} - \beta \Delta \Phi_{ij}$

[NODE STATE ENGINE]
  ↳ Tracks $\Psi_i(t)$ phase at each node
  ↳ Adjusts phase based on local E(x,t) gradients

[FIDELITY METRICS]
  ↳ Calculates global coherence fidelity:
  $F_{total} = \Sigma |\Psi_i(t) - \Psi_j(t)|^2 / N$

[VISUALIZATION MODULE]
  ↳ Displays lattice grid
  ↳ Color-coded entropy fields, node phase angles, ΔF over time

[OUTPUT + EXPORT]
  ↳ Saves session data
  ↳ Exports animation frames and fidelity logs

4. Technical Stack (Proposed)

- Frontend: React.js or WebGL interface
- Backend Simulation Core: Python (NumPy, SciPy), or Rust for speed
- Visualization: D3.js or Plotly for dynamic entropy mapping
- Optional CMB Integration: Planck 2018 FITS file parser
- Export: CSV for data logs, MP4/JSON for animated sessions

5. Development Roadmap

Phase 1: Grid Engine + Node State Engine (core simulation loop)
Phase 2: Visualizer + Fidelity Calculations
Phase 3: Real CMB Data Loader + Controls
Phase 4: UI Design + Save/Load/Export Options
Phase 5: Public Demo Site (qheatnet.org or haloheat.net)

6. MVP Completion Criteria

- Live lattice simulation with dynamic entropy injection
- Real-time coherence tracking and visualization
- Adjustable parameters for scientific experimentation
- Core scientific validation logic (ΔF response to entropy alignment)

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